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L5: Entry 3 of 3 File: USPT May 26, 1998

DOCUMENT-IDENTIFIER: US 5757801 A
TITLE: Advanced priority statistical multiplexer

Brief Summary Text (8):
Typically, a data multiplexer is used as an efficient alternative to traditional data communications in which a single channel uses a single telephone line link. By combining a plurality of asynchronous channels into a composite link, fewer telephone lines or leased lines and less equipment is used to transfer the data. This is especially cost effective when a four wire "leased" line is used to connect a pair of synchronous modems. This type of private line offers a degree of security that public dial-up telephone lines cannot match. In addition, the superior error correction of a synchronous multiplexer network is preferred over the single telephone line asynchronous connections. Better yet, the use of a digital line with a DSU (Digital Service Unit) connection is more reliable and error free than analog.

Brief Summary Text (15):
The total bandwidth of the composite link communicating between sites may be instantaneously allocated to high priority data (time sensitive) and low priority data (non-time-sensitive) based on instantaneous system demands. In voice over data communications it is possible to greatly reduce bandwidth allocated to the high priority voice packet information by eliminating transmissions of repeated silent packets. The voice detection algorithm tells the data processor that the packet is empty which is representative of silence. The data processor then does not send the packet, but instead sends a flag to the other side of the composite link to indicate no voice is being sent. In the event of silence, the maximum low priority data (asynchronous or synchronous data) packet size is dynamically changed based on the use of the voice channel. If there is a lot of silence, or the voice channel is not active at all, then the maximum low priority data packet size can grow to be quite large providing a larger asynchronous and synchronous data channel throughput. An advanced priority statistical multiplexer ensures maximum data throughput quality and efficiency while simultaneously reducing multiplexer processing overhead.

Drawing Description Text (25):
FIG. 20B shows a portion of the multiplexed high priority and low priority data transmitted by one embodiment of a two priority level advanced priority statistical multiplexer;

Detailed Description Text (39):
As described above, channel 1 and channel 2 of the voice/fax board are identical and correspond to Voice Channel Equipment (VCE) Channel 1 circuit 402a or VCE Channel 2 circuit 402b of FIG. 5. Only one channel circuit is shown in the electrical schematic diagrams of FIGS. 10A and 10B and the control signal labels shown in the electrical schematic diagram of FIG. 7B match by placing a "B" in front of any control signal label to indicate channel 1. For example, the signal E&ME of the electrical schematic diagram of FIG. 7B matches the signal E&ME of the electrical schematic diagram of FIG. 10A for channel 2 and the signal BE&ME of the electrical schematic diagram of FIG. 7B matches the signal E&ME of the electrical schematic diagram of FIG. 10A for channel 1. In FIGS. 10A and 10B, the FXS, FXO and E&M connections for the voice/fax card 402 are shown to the right of FIG. 10B. The E&M trunk line connector J5 handles both two-wire and four-wire interfaces.

Detailed Description Text (41):
Referring to FIGS. 9A-9I, connector J1 is the interface 607 with the main aggregate

board of FIG. 6B. The operational amplifiers in the top portion of FIG. 9B are used for gain control and level control of the analog voice signals. Not shown in these schematic diagrams are the AC (ring voltage) and DC voltage sources.

Detailed Description Text (182):
In one embodiment of the present invention, an advanced priority statistical multiplexing scheme is incorporated to maximize data throughput on any particular communication channel while preserving quality and reliability of high priority data and maintaining the efficiency of statistical multiplexing.

Detailed Description Text (183):
A proprietary advanced priority statistical multiplexing (APSM) paradigm is implemented in conjunction with the above-described modified HDLC protocol to allow high-priority (time sensitive) data such as voice, fax, LAN (local area network), synchronous, and video to be multiplexed with low priority data (such as asynchronous data) over a composite link. The fundamental difference between the two groups of data is the absence of the modified HDLC protocol overhead with high priority data. This absence of the modified HDLC protocol overhead is due to the time-sensitive nature of the high priority data which requires that the high priority data be transmitted and received with a minimal amount of delay. The time sensitive condition removes any type of error correction or detection scheme, any type of retransmissions or any type of acknowledgements that are associated with the modified HDLC protocol employed with high priority data.

Detailed Description Text (184):
This advanced priority statistical multiplexing uses variable-length packets and statistical multiplexing of low priority data for transmission efficiency and quality. Advanced priority statistical multiplexing also assures predictable and minimal delay of higher priority packets by interrupting low priority data transmission when higher priority data is ready for transmission.

Detailed Description Text (185):
Overview of High Prioritv and Low Priority Data

Detailed Description Text (186):
In general, packetized data may be categorized as high priority or low priority. Data which is designated as high priority data is time-critical data. Timecritical data is any data which must be transferred in a given time period due to the nature of the information transferred. Some examples of time-critical (high priority) data are voice and video data. An example of low priority data is asynchronous digital data, such as a binary file. Transmission and reception of voice data must occur regularly to ensure that the voice information is not delayed or garbled, however, binary files can be transferred in bursts and accumulated at the receiver over an extended period of time. Therefore the transmission of high priority data takes precedence over low priority data in order to meet the time criticality of the high priority data. If the communication channel has bandwidth in excess of that needed to transmit the maximum number of high priority data bytes, then there is bandwidth available for the transmission of low priority data. By multiplexing the low priority data within the transmissions of high priority data, the total bandwidth of the composite link can be exploited, resulting in greater throughput and efficiency of data transferred over the composite link.

Detailed Description Text (188):
FIG. 20A is a block diagram of one embodiment of the present invention. High priority data is transmitted, received, packetized and unpacketized by high priority packet module (HPPM) 2001. High priority packet module 2001 can be any transceiver of high priority data, such as voice/fax board 402, shown in FIG. 6C. High priority packet module 2001 may perform other functions as well, such as compression and decompression of high priority data. Low priority data is transmitted, received, packetized and unpacketized by low priority packet module (LPPM) 2003. Low priority packet module 2003 is any generator of low priority data, such as channel board 401, shown in FIG. 6A. Those skilled in the art will readily recognize that several other generators of high priority and low priority data are possible without departing from the scope and spirit of this embodiment of the present invention, and these examples are not offered in a limiting or exhaustive sense.

Detailed Description Text (191):
Another embodiment of the present invention includes multiple high priority packet modules 2001 which have independent high priority packet times. Such systems must use the shortest high priority packet time in order to preserve the time-criticality of each high priority packet in the system. Additionally, there are other embodiments of the present invention having network topologies which result in high priority packet traffic passing through a node. The advanced priority statistical multiplexing scheme must account for the worst case number of high priority generators in each node to determine both the smallest high priority packet time and the largest number of high priority packets which may be transmitted during that high priority packet time. This information is necessary to ensure that the high priority data is given priority in the time multiplex and that the composite link will have sufficient bandwidth to handle the worst case high priority traffic.

Detailed Description Text (195):
In the present system, if the bandwidth of the sampled high priority data is much lower than the bandwidth of the composite link over which it is communicated, then the high priority data appears as packetized bursts over the composite link. As the bandwidth of the high priority data approaches the bandwidth of the composite link, the high priority data appears as a continuous transmission of data, with few spaces interspersed. As long as the bandwidth of the composite link exceeds the bandwidth of the high priority data there is room for multiplexed transmission of low priority data.

Detailed Description Text (196):
However, the multiplexing problem is complicated by the fact that high priority data packets may be generated in different combinations, resulting in varying burst lengths. Two approaches to multiplexing such data are: (1) reserving an interval in the time multiplex for the maximum number of high priority data bytes which potentially could be sent by the system and transmitting low priority bytes around this `reserved space` in the time multiplex; and (2) by transmitting high priority data bytes whenever they are generated and instantaneously packing low priority data bytes around the high priority data bytes.

Detailed Description Text (197):
Method (1) is adequate if the statistical variation in high priority packet length is relatively small when compared to the average packet length, however, if large fluctuations in high priority packet length are observed, then method (1) results in a substantial loss of unused bandwidth which could be exploited for transmission of low priority data. Method (2) can utilize the entire bandwidth of the composite link, but is much more processor intensive than method (1) due to constant monitoring for gaps in high priority data.

Detailed Description Text (200):
The resulting data transmissions can be characterized by various indices such as high priority packet time (HPPT) which is a measure of the time high priority packet module 2001 needs to construct a high priority packet. The high priority packet time is commensurate with the sampling rate of the high priority input and is dictated by the nature of the high priority signal, level of compression of that signal, and requisite bandwidth. Each high priority packet is loaded into shared memory 2002 by high priority packet module 2001 for later transmission by aggregate module 2005. Aggregate module 2005 transceives the packets at the same rate as high priority packet module 2001 so each packet will be transferred within one high priority packet time, ensuring that the high priority data is timely. If the high priority packet module 2001 is the voice/fax card 308, then the high priority packet time is dependent on the speech compression algorithm selected. For example, the earlier section entitled "Speech Compression Algorithm" described a 20 ms speech sample time. In this case the high priority packet time would be 20 ms, since voice packets are generated and must be processed every 20 ms. The high priority packet time multiplied by the overall baud transmission rate of the link sets the maximum bandwidth (in bytes) which may be allocated to high priority packet transmission, known as HPPT.sub.n. Another index is the interrupt boundary byte count (IBBC), which is the excess overhead of the communications channel assuming the maximum number of high priority packet bytes were continually transmitted. The calculation

of the interrupt boundary byte count is described below by the following pseudocode procedures:

Detailed Description Text (209):
In this embodiment of the present invention aggregate module 2005 monitors for and detects pending high priority packet and low priority packet data in order to properly multiplex the pending data. Pending high priority data is high priority data stored in common memory 2002 and awaiting transmission via aggregate module 2005. Similarly, pending low priority data is low priority data stored in common memory 2004 and awaiting transmission via aggregate module 2005. If aggregate module 2005 polls the shared memories 2002 and 2004 and determines that the only pending data is high priority packet data, voice or fax data, for example, then aggregate module 2005 transmits a voice frame according to the protocol given in FIG. 16. If aggregate module 2005 has only digital asynchronous data to transfer, then the packet is sent according to the asynchronous channel data frame of FIG. 18. If high priority packet data is pending during the transmission of low priority packet data, this embodiment of the present invention will interrupt the low priority packet data transmission on the IBBCth byte of low priority packet data transfer to insert the high priority packet data with an identifying header byte to denote which type of data follows. This way the interpreter at the receiving end need only scan the first byte of header information on every IBBC+1th word to determine whether the following data is high priority packet or low priority packet data. Therefore, in this embodiment of the present invention, the voice/fax frame of FIG. 16 contains only voice/fax data, however, the asynchronous channel data frame of FIG. 18 is modified to include both low priority packet and high priority packet data, yielding a hybrid frame similar in format to FIG. 18. The hybrid frame length, F.sub.n, is limited by considerations such as buffer memory sizes and link speed.

Detailed Description Text (214):
1a. if only high priority packet data is pending, transmit the high priority packet data and complete the transmission of high priority packet data before sending low priority packet data or hybridized low priority packet and high priority packet data (transmission of the high priority data is according to the frame protocol of FIG. 16);

Detailed Description Text (225):
Using this algorithm, aggregate module 2005 polls for high priority data at the beginning of each transmission of a frame and in IBBC byte intervals measured from the transmission of the last high priority data byte. In one embodiment of the present invention the low priority packet module 2003 transfers packetized data to common memory 2004 upon three conditions: (1) reaching a predetermined maximum low priority packet packet byte count; (2) when a flash timer signals the transfer prior to filling the packet up to the packet byte count; or (3) if a high priority header occurs on the IBBC+1th byte in the hybrid stream. Therefore, X may be less than IBBC, since the low priority packet byte count is less than IBBC bytes in cases (1) and (2).

Detailed Description Text (227):
This method ensures that the high priority packet information is always current within every high priority packet time interval as long as the interrupt boundary byte count is greater than zero. The extent to which the interrupt boundary byte count exceeds zero is indicative of the available bandwidth for low priority packet data. Therefore, the bandwidths of both the high priority packet and low priority packet data are constantly changing to provide continuous transfer of high priority packet data, and maximum bandwidth for transfer of low priority packet data.

Detailed Description Text (228):
An alternate embodiment of the present invention combines the features of the above embodiment with an additional prioritization scheme for systems with multiple high priority packet modules. For example, if multiple high priority packet modules are transceiving information on the system, then latency for packets passing through the system can be minimized by transmitting the high priority and low priority packets in the following descending order:

Detailed Description Text (233):

Using this prioritization the latency for packets passing through is minimized.

Detailed Description Text (247):
In this embodiment of the present invention, transmission of purely high priority data (for example, voice/fax data) employs no error checking mechanisms. Defective high priority frames are discarded or used by the system without significant impact to transmission fidelity. Hybridized frames have error checking incorporated into both the voice and data portions of the frame, however, the receiver requests retransmission of only the corrupt data portions (low priority) of each transmission.

Detailed Description Text (249):
Advanced priority statistical multiplexing not only ensures high quality and efficient transmissions, but actually reduces processor overhead in the composite link as the aggregate baud rate of the link increases. As baud rates increase, typically interrupt boundary byte count values also increase, since a larger average number of low priority bytes may be transmitted with the high priority bytes. This results in less interrupts to the multiplexing hardware in aggregate module 2005 as link speed increases, since such interrupts are based on the interrupt boundary byte count. The result is an efficient, high quality throughput of the low priority and high priority data with a statistically minimal amount of processor overhead at both the transmitting and receiving ends, with improved efficiency with increasing baud rate.

Detailed Description Text (252):
FIG. 20B shows the output from one embodiment of a two priority level advanced priority statistical multiplexer. Data segment 2020 is an enlargement of one segment of duration equal to one high priority packet time taken from an output data stream 2010. The number of bytes which can be transmitted in one high priority packet time is HPPT.sub.n 2012. In order to graphically illustrate the interrupt boundary byte count, the high priority portion of the segment 2020 demonstrates the maximum number of high priority data bytes which can be transmitted in one high priority packet time, HPPT.sub.sum 2022. The difference between HPPT.sub.n 2012 and HPPT.sub.sum 2022 is the interrupt boundary byte count 2024. However, in ordinary transmissions the high priority portion of a segment may have anywhere from zero to HPPTsum bytes of high priority data.

Detailed Description Text (255):
Alternate Embodiments for Transmission of Intermediate Priority Data

Detailed Description Text (256):
FIG. 23 shows the topology of an alternate embodiment of the present invention incorporating a new data priority level. FIG. 23 is similar to FIG. 20A in that it illustrates a low priority packet module 2303, common memories 2304 and 2302, and high priority packet module 2301, but shows the addition of a medium priority packet module (MPPM) 2310 which communicates with an advanced aggregate module 2305 via common memory 2312. Medium priority packet module 2310 generates medium priority data, which is data with less time-criticality than high priority data but greater time-criticality than the low priority data. An example of medium priority data is synchronous data or LAN data. The medium priority information is multiplexed with the high priority data and the low priority data by assigning primary priority to high priority data, secondary priority to the medium priority data, and third priority to the low priority data.

Detailed Description Text (257):
The addition of medium priority data to the present invention requires that the excess non-high priority bandwidth be shared between the low priority data and the medium priority data, based on system needs and the particularities of the low priority and medium priority data. In one embodiment of the present invention the medium priority data takes absolute precedence over the low priority data transferred. Therefore, after all the high priority data is transferred, all medium priority data is transferred before low priority data can be transferred. In another embodiment of the present invention low priority data and medium priority data can share the non-high priority bandwidths during transmissions, so as to not transfer all medium priority information prior to the transfer of low priority information.

This may be accomplished by setting a medium priority maximum bandwidth, which must be selected to satisfy the transmission requirements of the medium priority data, yet still transfer some low priority data. For instance, the system could transfer high priority information as stated in earlier embodiments and then transfer only 100 byte increments of the medium priority data, depending on the interrupt boundary byte count, filling the remaining bandwidth with low priority data.

Detailed Description Text (258):
The aspects taught for the low and high priority data in preceding sections apply directly to intermediate level systems. Calculation of the various transmission indices is for a three level system is identical to that for a two level system, except that the interrupt boundary byte count must be shared between the medium and low priority data. The multiplexing and demultiplexing schemes are similar as well, except new identification bytes must be used to identify intermediate priority packets in the frame. In addition, further checking will be needed to ensure that those new identification bytes are not misinterpreted by the receiver by checking the IBBC+1th byte for both high priority and intermediate priority identification codes.

Detailed Description Text (261):
Many of the examples given in this description concern the voice over data application of advanced priority statistical multiplexing, however, several other applications exist and the concepts of low, high, and intermediate priority data apply equally well to those applications as well. In specific voice over data embodiments the words "voice data" and "high priority data" were often used interchangeably, as were "asynchronous data" and "low priority data". Those skilled in the art will readily appreciate that the concepts of the present invention which were applied to high priority, intermediate priority, and low priority data are applicable to a variety of transmissions and are not limited to the specific embodiments presented. High priority data could be video as well as voice. Intermediate priority data could be synchronous data or LAN data. Other variations known to those skilled in the art are included as well.

CLAIMS:

1. A method for multiplexing high priority data and low priority data for transmission over a communications link, the communications link having a bit rate, the communications link transferring bytes, each byte having Y bits, and the communications link having a byte transfer period equal to Y divided by the bit rate, the method comprising the steps of:

a. determining a high priority packet time;

b. determining a maximum number of bytes transferred across the communications link in the high priority packet time by dividing the high priority packet time by the byte transfer period;

c. determining a worst case number of high priority data bytes transferred over the communications link in the high priority packet time;

d. subtracting the worst case number of high priority data bytes of step c from the maximum number of bytes of step b to obtain an interrupt boundary byte count; and

e. multiplexing high priority data bytes and low priority data bytes, wherein the step of multiplexing includes the steps of:

1) if there are one or more of the high priority data bytes to be transferred across the link, transmitting the one or more of the high priority data bytes, concluding with a final high priority data byte;

2) if there are one or more of the low priority data bytes to be transferred across the link, transmitting up to K bytes of the one or more of the low priority data bytes, where K does not exceed the interrupt boundary byte count;

3) waiting V byte transfer periods, wherein V equals the interrupt boundary byte

count minus K; and

4) returning to step 1).

2. The method of claim 1 wherein the step of transmitting the one or more of the high priority data bytes comprises the step of transmitting voice data.

3. The method of claim 1 wherein the step of transmitting the one or more of the high priority data bytes comprises the step of transmitting facsimile data.

4. The method of claim 1 wherein the step of transmitting the one or more of the high priority data bytes comprises the step of transmitting video data.

5. The method of claim 1 wherein the step of transmitting up to K bytes of the one or more of the low priority data bytes comprises the step of transmitting asynchronous digital data.

6. A method for transmitting high priority data and low priority data over a communications link in a hybrid data frame having a frame length equal to F.sub.n bytes, the communications link having a bit rate, the communications link transferring bytes, each byte having Y bits, and the communications link having a byte transfer period equal to Y divided by the bit rate, the method comprising the steps of:

a. determining a high priority packet time;

b. determining a maximum number of bytes transferred across the communications link in the high priority packet time by dividing the high priority packet time by the byte transfer period;

c. determining a worst case number of high priority data bytes transferred across the communications link in the high priority packet time;

d. subtracting the worst case number of high priority data bytes from the maximum number of bytes to obtain an interrupt boundary byte count; and

e. transmitting high priority data bytes and low priority data bytes, including the steps of:

1) setting a frame length count equal to the frame length;

2) transmitting header information;

3) if there are one or more of the high priority data bytes to be transferred across the link, transmitting the one or more of the high priority data bytes, concluding with a final high priority data byte, and decrementing the frame length count for each high priority data byte transmitted;

4) if there are one or more of the low priority data bytes to be transferred across the link, transmitting up to K bytes of the one or more of the low priority data bytes, where K does not exceed the interrupt boundary byte count, and decrementing the frame length count K times;

5) waiting V byte transfer periods, wherein V equals the interrupt boundary byte count minus K; and

6) repeating steps 3) , 4) and 5) until the frame length count is equal to zero.

7. The method of claim 6, wherein the step of transmitting high priority data bytes and low priority data bytes further comprises the step of transmitting error correction codes.

8. The method of claim 6, wherein the step of transmitting the one or more of the high priority data bytes firther comprises the step of transmitting a high priority data identification byte, and wherein the step of transmitting up to K bytes of the

one or more of the low priority data bytes further comprises the step of transmitting a low priority data identification byte.

9. A method for demultiplexing frames of packetized high priority data and low priority data, the low priority data packed into a hybrid frame in interrupt boundary byte count (IBBC) increments, the method comprising the steps of:

a. determining a frame length, wherein F.sub.n equals the frame length of the hybrid frame;

b. setting a frame length counter equal to F.sub.n ;

c. reading an identification byte;

d. decoding the identification byte to determine whether high priority data or low priority data is being received;

e. if low priority data bytes are being received, reading Y of the low priority data bytes and subtracting Y from the frame length counter, where Y is not greater than the interrupt boundary byte count;

f. if high priority data is being received:

1. determining a length X of the high priority data; and

2. reading X bytes of the high priority data; and

g. if the frame length counter is a positive, nonzero number, continuing to demultiplex at step c.

12. The method of claim 9 wherein the step of determining a length of the high priority data includes reading header information in the identification byte of the high priority data.

13. The method of claim 9 wherein the step of determining a length of the high priority data includes referring to a lookup table to obtain a high priority data frame length.

14. A method for multiplexing high priority data, intermediate priority data, and low priority data for transmission across a communications link, the link having a maximum bandwidth with a byte transfer period equal to an amount of time needed to transfer one byte of data over the communications link, the method comprising the steps of:

a. determining a high priority packet time;

b. determining a maximum number of bytes transferred in the high priority packet time;

c. determining a worst case number of high priority data bytes transferred in the high priority packet time;

d. subtracting the worst case number of high priority bytes from the maximum number of bytes to obtain an interrupt boundary byte count;

e. storing the high priority data in a first memory, the intermediate priority data in a second memory, and the low priority data in a third memory; and

f. multiplexing the high priority data, the intermediate priority data, and the low priority data, wherein the step of multiplexing includes the steps of:

1. if there is high priority data, transmitting the high priority data, including a final high priority data byte;

2. transmitting a number of bytes of the intermediate priority data and the low

priority data, wherein the number of bytes equals J bytes, and wherein J is not greater than the interrupt boundary byte count;

15. The method of claim 14 wherein step 2 further includes the step of transmitting all intermediate priority data bytes prior to transmitting low priority data bytes.

16. The method of claim 14 wherein step 2 further includes the step of transmitting a number of intermediate priority data bytes prior to transmitting low priority data bytes where the number is equal to X, wherein X is not greater than the interrupt boundary byte count.

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L5: Entry 1 of 3 File: USPT Jul 23, 2002

DOCUMENT-IDENTIFIER: US 6424646 B1
TITLE: Integrated services director (ISD) overall architecture

Detailed Description Text (2):
Referring to FIG. 1, a first exemplary communication network architecture employing a hybrid fiber, twisted-pair (HFTP) local loop 1 architecture is shown. An intelligent services director (ISD) 22 may be coupled to a central office 34 via a twisted-pair wire, hybrid fiber interconnection, wireless and/or other customer connection 30, a connector block 26, and/or a main distribution frame (MDF) 28. The ISD 22 and the central or local office 34 may communicate with each other using, for example, framed, time division, frequency-division, synchronous, asynchronous and/or spread spectrum formats, but in exemplary embodiments uses DSL modem technology. The central office 34 preferably includes a facilities management platform (FMP) 32 for processing data exchanged across the customer connection 30. The FMP 32 may be configured to separate the plain old telephone service (POTS) from the remainder of the data on the customer connection 30 using, for example, a tethered virtual radio channel (TVRC) modem (shown in FIG. 4A). The remaining data may be output to a high speed backbone network (e.g., a fiber-optic network) such as an asynchronous transfer mode (ATM) switching network. The analog POTS data may be output directly to a public switch telephone network (PSTN) 46, and/or it may be digitized, routed through the high speed backbone network, and then output to the PSTN 46.

Detailed Description Text (6):
Referring to FIG. 2, the ISD 22 may connect with a variety of devices including analog and digital voice telephones 15, 18; digital videophones 130, devices for monitoring home security, meter reading devices (not shown), utilities devices/energy management facilities (not shown), facsimile devices 16, personal computers 14, and/or other digital or analog devices. Some or all of these devices may be connected with the ISD 22 via any suitable mechanism such as a single and/or multiple twisted-pair wires and/or a wireless connection. For example, a number of digital devices may be multi-dropped on a single twisted-pair connection. Similarly, analog phones and other analog devices may be multi-dropped using conventional techniques.

Detailed Description Text (16):
In some embodiments, the FMP 32 may include an access module 70 and a digital loop carrier 87. The access module 70 may include a line protector 71, a cross-connector 73, a plurality of TVRC modems 80, a plurality of digital filters 82, a controller multiplexer 84, and/or a router and facilities interface 86. The digital loop carrier 87 may include a plurality of line cards 96, a time domain multiplexing (TDM) multiplexor (MUX) 88, a TDM bus 90, a controller 92, and/or a facilities interface 94.

Detailed Description Text (17):
During normal operations, digital signals on the customer connection 30 (e.g., twisted-pair lines) containing both voice and data may be received by the TVRC modems 80 via the line protector 71 and the cross-connector 73. Preferably, the line protector 71 includes lightning blocks for grounding power surges due to lightning or other stray voltage surges. The TVRC modems 80 may send the digital voice and/or data signals to the controller multiplexor 84 and the digital filters 82. The digital filters 82 may separate the voice signals from the digital data signals, and the controller multiplexor 84 may then multiplex the voice signals and/or data signals received from the digital filters 82. The controller multiplexor 84 may then send multiplexed voice signals to the TDM MUX 88 and the data signals to the router

and facilities interface 86 for transmission to one or more external networks. The TDM MUX 88 may multiplex the voice signals from the controller multiplexor 84 and/or send the voice signals to the TDM bus 90, which may then send the digital voice signals to the controller 92 and then to the facilities interface 94 for transmission to one or more external networks. Both the router and facilities interface 86 and the facilities interface 94 may convert between electrical signals and optical signals when a fiber optic link is utilized.

Detailed Description Text (25):
A basic Premises Distribution Network (PDN) 500 for one exemplary embodiment of a typical residential application of the ISD 22 is shown in FIG. 5. The premise distribution network 500 may include one or more Ethernet connections 501 for connecting a plurality of devices such as a number of personal computers 14A, 14B, a vision phone, and/or other devices. Further, the premise distribution network 500 may include any number of conventional analog lines 505 (e.g., Tip/Ring (T/R) phone lines), each having one or more associated analog phones (e.g., 15A-15n), and/or associated Pcs with modem and/or phone cards. Further, the premises distribution network 500 may include any number of ISDN lines 506, each having any number of digital appliances such as ISDN compliant devices and/or video phones 130. The premises distribution network 500 may use existing twisted pair telephone line and/or may utilize a special cable to facilitate Ethernet and/or other LAN connections. Where the video phone 130 shares the same LAN as a connected PC 14A, prioritization software in the LAN driver gives priority to video and/or audio transmissions to and from the video phone to reduce latency time and unpredictable delays. Alternatively, the video phone 130 may be coupled via a dedicated ISDN connection, a dedicated ethernet connection, and/or another dedicated connection to the ISD 22. The video phone may have an integrated analog phone for life line support. Alternatively, one of the analog phones serves the function of providing lifeline support. Where the video phone 130 includes lifeline support, it is preferred to transmit data to the phone in a band above 7 KHz using ADSL like modem technology.

Detailed Description Text (35):
For example, with reference to FIG. 6, information may be multiplexed into one or more DSL frames in order to dynamically allocate bandwidth. In one exemplary embodiment, where data is being input to one of the connected data devices (e.g., a PC), and a voice call comes in, a dynamic allocation of bandwidth may occur. Assume that 1 Mbps is available for information transfer. Prior to the incoming call, all 1 Mbps may be completely used for the data transmission. However, as soon as a voice call comes in, since voice has a higher priority than data, a 64 Kbps channel is deallocated from data usage and is allocated for voice. If a second voice call comes in, then another data channel will be deallocated from data usage and allocated for voice. As a voice call gets terminated, then the allocated voice slots will be reallocated to use by data and/or another voice channel. For example, as shown in FIG. 6B, voice call 4 V4 is terminated and the bandwidth is reallocated to D3. Accordingly, as the bandwidth is reallocated, the header may be updated to reflect the new bandwidth allocation. This allocation may occur in both the CPE to network traffic and network to CPE traffic. Additionally, as slots are added to CPE to network traffic, slots may be deallocated to network to CPE traffic implementing a dynamic asymmetric bandwidth allocation. Hence, the system dynamically allocates bandwidth in real time to maximize information transfer. Where individual packets are used to transport voice and data between the ISD 22 and the FMP 32, an individual channel doe not need to be allocated. Voice packets are simply given priority over data packets in the transfer. Therefore, silence periods may be used to the advantage and a higher overall bandwidth occurs. Data is simply stored in the buffer and/or slowed in its transfer using standard flow control where voice has priority. In aspects of the present invention, bandwidth may be allocated on a per-frame basis. By contrast, conventional systems only allocated bandwidth at the time a secession is initiated--and once initiation has been completed, bandwidth allocation cannot be changed without tearing down the call. However, in aspects of the present invention, bursty data may be accommodated more efficiently since the burst data rate may be accommodated via dynamic bandwidth allocation.

CLAIMS:

11. The method of claim 1, wherein the first pieces of customer premises equipment include a home security device.

16. The method of claim 1, wherein said step of allocating the transmission capacity of said telephone connection includes dynamically allocating an available bandwidth according to the first and second priority levels.

29. The method of claim 19, wherein the first pieces of customer premises equipment include a home security device.

34. The method of claim 19, wherein said step of allocating the transmission capacity of said telephone connection includes dynamically allocating an available bandwidth according to the first and second priority levels.